# Nonlinear Behaviour of a 17th Century Masonry Building within Dubrovnik's Old City Subjected to Successive Earthquakes

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## Abstract

Dubrovnik, a historic city located in a region of high seismic activity, has repeatedly been struck by destructive earthquakes, confirming its long-term exposure to seismic risk. This study focuses on a representative historical masonry building within the Old City, with the aim of assessing its seismic resistance and the accumulation of damage under repeated earthquake actions. A numerical model was developed in SAP2000 using the nonlinear layered shell elements. The soil–structure interaction was assumed as fixed, while the effect of timber floor structures was neglected due to their limited contribution to the global response. A nonlinear material curve was defined according to available literature, and the model was subjected to a real ground motion record of the 1979 earthquake, scaled to the reference ground acceleration for three different return periods. Special attention was given to the distribution of tensile and shear stresses, loss of load-bearing capacity, and the assessment of damage levels. The reduction of capacity after seismic damage was simulated by modifying the material curve following the guidelines of FEMA 306. The results were interpreted through comparisons of stresses, displacements, natural periods, and EMS-98 damage classifications, confirming a progressive degradation of resistance under repeated seismic actions. The findings highlight the urgent need for strengthening measures and the application of modern conservation techniques in order to enhance seismic safety and ensure the long-term functionality of Dubrovnik's historic core.

Key words: Historic masonry buildings, Seismic vulnerability, Nonlinear analysis, Damage assessment, Conservation strategies